Marital status and suicide in the National Longitudinal Mortality Study

Augustine J Kposowa

Abstract

Objectives—The purpose of the study was to examine the effect of marital status on the risk of suicide, using a large nationally representative sample. A related objective was to investigate the association between marital status and suicide by sex.

Methods—Cox proportional hazards regression models were applied to data from the National Longitudinal Mortality Study, based on the 1979–1989 follow up. In estimating the effect of marital status, adjustments were made for age, sex, race, education, family income, and region of residence.

Results—For the entire sample, higher risks of suicide were found in divorced than in married persons. Divorced and separated persons were over twice as likely to commit suicide as married persons (RR=2.08, 95% confidence intervals (95% CI) 1.58, 2.72). Being single or widowed had no significant effect on suicide risk. When data were stratified by sex, it was observed that the risk of suicide among divorced men was over twice that of married men (RR=2.38, CI 1.77, 3.20). Among women, however, there were no statistically significant differentials in the risk of suicide by marital status categories.

Conclusions—Marital status, especially divorce, has strong net effect on mortality from suicide, but only among men. The study showed that in epidemiological research on suicide, more accurate results would be obtained if samples are stratified on the basis of key demographic or social characteristics. The study further observed that failure to control for relevant socioeconomic variables or combining men and women in the same models could produce misleading results.

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Previous studies have reported a link between marital status and suicide.[1–3] They have shown that married persons experience lower suicide rates than single, never married people, and that divorced, separated and widowed persons have the highest rates.[2 4] One of the most prominent explanations given in past studies to account for the observed differentials in the risk of suicide by marital status is that marriage provides social and emotional stability, whereas divorce, separation, singlehood and widowhood do not.[1 5] Accordingly, marriage offers the best protection against suicide because it provides social and community integration, and reduces social isolation.[1 3 6]

An issue that remains relatively unresolved in public health research is whether the reported protection provided by marriage against suicide holds for men and women equally. In addition, past studies that have reported associations between marital status and suicide have failed to control for the potentially confounding effects of socioeconomic variables. For example, in a previous report, divorced persons were found to be 2.9 times as likely to die of suicide than married people.[2] Widowed persons were observed to be 2.8 times more likely to die from suicide compared with married persons, and single people experienced a suicide risk that was 1.9 times that of married people. However, that study controlled for only age.[2] A more recent research also controlled for only age in studying the effect of marital status on suicide.[4] Hence, it is unknown whether the observed relation between marital status and suicide would remain after socioeconomic factors are taken into account.

In this study, a nationally representative sample is used to examine the risk of suicide by marital status. More specifically, the following questions are asked: (1) Are divorce, widowhood, and being single significant risk factors for suicide? (2) Do these risks vary by sex? (3) Does the effect of marital status remain after controlling for socioeconomic variables? (4) What are implications of answers to the above questions for research and public health policy?

Methods

DATA SOURCE

The National Longitudinal Mortality Study (NLMS), 1979–1989 was used to estimate the effects of marital status on death from suicide.[7] The NLMS is a prospective study of mortality among the non-institutionalised population of the United States.[8 9] The samples are derived from the Current Population Survey (CPS), which is conducted by the US Bureau of the Census.[10 11]

The CPS is a joint project between the US Bureau of Labor Statistics and the US Bureau of the Census. It is a complex national survey based on a sample of about 50 000 households conducted monthly, and it is the primary source of information on the labour force characteristics of the population of the United States. In the CPS, comprehensive information is given or collected on the employment status, occupation, and industry of persons 15 years old and older. Additional data are obtained concerning weeks worked and hours per week worked, reason for not working full time, total income, and income components. Information

University of California, Riverside, USA

Correspondence to:
Augustine J Kposowa, Department of Sociology, 1214 Watkins Hall, University of California, 900 University Avenue, Riverside, CA 92521, USA.

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is also collected on demographic characteristics, such as age, sex, race, household relationship, and Hispanic origin for each person in the household.

In the CPS, a stratified cluster sample of households is obtained, and monthly personal and telephone interviews are conducted with the most knowledgeable adult member of the household. Each month, interviewers contact the sampled units to obtain information on social, economic, and demographic characteristics about all persons residing at the address.[10] To improve the reliability of estimates of month to month and year to year change, eight panels are used to rotate the sample each month. A sample unit is interviewed for four consecutive months, and then after an eight month rest period, for the same four months a year later. Each month a new panel of addresses, or one eighth of the total sample, is introduced. Thus, in a particular month, one panel is being interviewed for the first time, one panel for the second, one panel for the third, one panel for the fourth, one panel for the fifth, one panel for the sixth, one panel for the seventh, and one panel for the eighth and final time.[10] The CPS has a response rate of 96%.[10 11]

The public use data file employed in this study consisted of a cohort of five national samples derived from the CPSs conducted in March 1979, April, August, and December 1980, and March 1981. The mortality experiences of the cohort members were studied until 1989.[8–10]

Data from death certificates on the fact and cause of deaths occurring in 1979 to 1989 were matched with the socioeconomic and demographic characteristics of the 1979–81 population cohorts using the National Death Index (NDI) to link the two databases.[12]

The NDI was originally designed to provide a simplified method of identifying the mortality experiences of participants in prospective studies. The NDI is a centralised and computerised index of death records that began with deaths in 1979. It is maintained by the National Center for Health Statistics using information provided by state and vital statistics offices.[12] A more detailed description of the data collection process, including cohort selection, sampling, reliability, and weighting has been presented elsewhere.[8–11]

VARIABLES AND MEASURES

The dependent variable was the risk of suicide. Deaths resulting from suicide were identified using cause of death codes E950–E959 from the *International Classification of Diseases, Ninth Revision, Clinical Modification*.[13] In estimating the risk of overall mortality from suicide, all persons surviving beyond the nine year follow up and those dying during the follow up from causes other than suicide were treated as right censored observations.

The sample comprised 471 922 people 15 years and above at the beginning of the study, of whom 545 had committed suicide by the end of the nine year follow up period. The present analysis was restricted to suicides among non-Hispanic white, non-Hispanic African American, and Hispanic men and women. Other racial/ethnic groups (Asians and Native Americans) were excluded because only 11 people committed suicide among them during the follow up period. This number was determined to be too small for meaningful statistical analysis.

The risk of suicide was estimated as a function of marital status, and of control variables including age, sex, race/ethnicity, education, family income, and region of residence.

Marital status at the beginning of follow up was measured by four dummy variables, one for single (never married), one for those currently married, one for widows, and one for those divorced or separated. Following the practice of most epidemiological studies, persons currently married at the beginning of the study constituted the reference category.[2 14 15]

Age at the baseline was captured by defining it in terms of series of dummy vectors, one each for age groups 15–24, 25–34, 35–44, 45–54, 55–64, and 65 and above. The age group 15–24 served as the reference category.

Race/ethnicity was defined in terms of two dummy variables, one for non-Hispanic African Americans and one for Hispanics. Non-Hispanic whites, who have generally experienced the highest rates of suicide in the United States constituted the reference group.

Education was measured by a series of dummy variables, one for 0–8 years of schooling, one for 9 to 11 years of education, one for high school education (12 years), and one for 13 to 15 years. People with 16 or more years of schooling constituted the reference group.

Annual family income (adjusted for inflation to 1980 dollars) was indexed by five dummy variables, one each for less than $5000, $5000–$9999, $10 000–19 999, $20 000–$24 999, and one for unknown income. Those with family incomes of $25 000 or more were the omitted group.

Region of residence was obtained by dividing the country into two main regions, west and non-west. Past studies, especially in sociology have reported an east-west gradient in suicide in the United States, with both divorce and suicide being highest in the western states.[3 6 16] Although no theoretical explanation has been given for this empirical phenomenon, to reduce the likelihood of drawing false inferences, I controlled for western residence. Region of residence was measured as a dummy variable with western states, as defined by the US census,[17] coded 1, and other states coded 0. The states coded 1 include: Alaska, Arizona, California, Hawaii, Montana, Nevada, Oregon, Utah, and Washington.

STATISTICAL METHODS

Cox's proportional hazards model was applied to the NLMS data to compare the risk of suicide among marital status groups while controlling for confounders, including age, sex, race, education, income, and region of residence.[18] Effect modification was evaluated by using multivariate hazard functions with interaction terms for sex and marital status. I report point estimates and 95% confidence

intervals of the relative risks of suicide for the total sample, and for men and women separately.

Results

The procedure of data analysis is twofold. The first is to examine the effect of marital status on the risk of suicide, and the second is to determine if there are differentials by sex.

There were 471 922 men and women 15 or more years old in the NLMS with known values for marital status and the control variables at baseline. Of this number, 545 persons were identified as having died from suicide during the follow up period, 1979 to 1989.

FINDINGS ON THE ENTIRE SAMPLE

Table 1 shows the distribution of the sample by marital status categories and control variables. The statistical significance ($p < 0.05$ or 0.01) of the relative risk for each covariate category, relative to the reference group is provided. Likelihood ratio statistics (LRS) and χ^2 values are also given. These statistics may be used by the reader to judge whether the addition of more variables to a given model produced a statistically significant result and a better fit of the model to the data.

Model 1 (table 1) presents the relative risks of suicide adjusted for only age in each covariate category. As may be seen, divorced persons were significantly more likely to die from suicide than their married counterparts (RR=1.76, 95%CI=1.35, 2.28). Results in model 1 further show that the risk of suicide among the widowed was significantly less than that of married persons (RR=0.66, 95%CI=0.45, 1.05). The likelihood ratio for model 1 comprising only marital status and age was 14151.29 (χ^2=39.71, df=6, p < 0.01).

Other results worth noting include the finding that men were over four times as likely to commit suicide as women (RR=4.45, 95%CI=3.62, 5.47). Persons residing in the western area of the United States had increased risks of suicide (RR=1.47, 95%CI=1.14, 1.88). As expected, the elderly experienced much higher risks of suicide. Persons 55–64 years old were 35% more likely to commit suicide as those 15–24 years old. Similarly, adults that were 65 years or more had a suicide risk that was 55% higher than that of persons 15–24 years old.

Model 2 (table 1) shows results after adjustment for age, race, sex, education, income, and region of residence. The likelihood ratio for the expanded model was 13841.62 (χ^2=349.38,

Table 1   Population size, distribution of suicides, crude and adjusted relative risks by marital status: entire sample

Marital status	Suicides	Population at risk	Model 1†		Model 2‡	
			RR	95% CI	RR	95% CI
Marital status						
Married	310	279 969	1.00	(Reference)	1.00	(Reference)
Single	132	116 510	1.26	0.96, 1.64	1.09	0.83, 1.43
Divorced	69	37 593	1.76***	1.35, 2.28	2.08***	1.58, 2.72
Widowed	31	34 082	0.66**	0.45, 1.05	1.26	0.83, 1.89
Unknown	3	3 768	0.80	0.25, 2.50	0.54	0.05, 5.62
Sex						
Female	113	248 290	1.00	(Reference)	1.00	(Reference)
Male	432	223 519	4.45***	3.62, 5.47	4.78***	3.86, 5.93
Race/ethnicity						
White	496	400 878	1.00	(Reference)	1.00	(Reference)
African American	24	45 789	0.43***	0.28, 0.65	0.39***	0.26, 0.59
Hispanic	25	25 555	0.81	0.54, 1.21	0.70	0.47, 1.06
Education						
16+ years	60	64 988	1.00	(Reference)	1.00	(Reference)
0–8	97	69 511	1.42**	1.01, 1.98	1.50**	1.05, 2.14
9–11	106	89 915	1.26	0.91, 1.75	1.42**	1.01, 1.98
12	188	170 653	1.17	0.87, 1.57	1.38**	1.02, 1.86
13–15	91	73 658	1.35	0.97, 1.87	1.47**	1.06, 2.05
Unknown	3	3 197	1.06	0.33, 3.39	2.02	0.19, 20.58
Household income						
$25 000+	130	125 865	1.00	(Reference)	1.00	(Reference)
<$5000	53	44 729	1.12	0.80, 1.56	1.32	0.93, 1.88
$5000–$9999	102	70 130	1.38***	1.05, 1.80	1.47***	1.11, 1.95
$10 000–$19 999	151	139 375	1.05	0.83, 1.34	1.05	0.83, 1.34
$20 000–$24 999	84	62 981	1.31**	0.99, 1.72	1.28	0.97, 1.70
Unknown	25	28 242	0.83	0.54, 1.28	0.84	0.53, 1.32
Region of country						
Non-West	474	426 855	1.00	(Reference)	1.00	(Reference)
West	71	45 067	1.47***	1.14, 1.88	1.40***	1.09, 1.81
Age (y)						
15–24	114	111 163	1.00	(Reference)	1.00	(Reference)
25–34	97	101 199	0.86	0.67, 1.10	0.87	0.67, 1.12
35–44	125	118 526	1.02	0.81, 1.28	1.06	0.80, 1.39
45–54	73	62 022	1.10	0.82, 1.45	1.17	0.83, 1.64
55–64	82	59 580	1.34**	1.02, 1.76	1.41**	1.01, 1.95
65+	93	67 928	1.55***	1.19, 2.01	1.61***	1.13, 2.27
LRS					13 841.62	
Model χ^2					349.38***	
df					23	
Number of suicides:		545				
Number of observations:		471 922				

Source: The National Longitudinal Mortality Study, 1979–1989. †Relative risks (RR) adjusted for age only. ‡Relative risks (RR) adjusted for age, race, sex, education, income, and region of residence. **Significant at p<0.05, ***significant at p<0.01. LRS = Likelihood ratio statistic, df = degrees of freedom.

df=23, p < 0.01). A change in log-likelihood was computed to determine if the addition of socioeconomic and other control variables made any significant contribution to the fit of the equation as a whole. The formula used was:

$$\Delta LRS = LRS_{model\ 1} - LRS_{model\ 2}$$

where ΔLRS = change in the likelihood ratio statistic. The resulting statistic has a χ^2 distribution under the null hypothesis of no significant effect of the additional (control) variables. For more on the likelihood ratio difference test see Kleinbaum[20] and Long.[21]

The difference in likelihoods (ΔLRS) was 325.19. Increased at 20 degrees of freedom (the absolute difference in degrees of freedom between the two models), this value was statistically significant (p < 0.01).

Having rejected the null hypothesis of no effects of the control variables, the next step was to determine the effect of marital status after adjusting for the effects of socioeconomic and other variables. As may be seen in model 2 (table 1), divorced and separated people were over twice as likely to die from suicide as their married counterparts (RR=2.08, 95%CI=1.58, 2.72). Not only was the impact of divorce and separation on the risk of suicide not reduced, but it actually increased. It went from 1.76 (in model 1) to 2.08 (in model 2), reflecting an increase of 18%. Other marital status categories (being single, widowed, or having unknown marital status) were unrelated to suicide.

Men were nearly 4.8 times as likely to commit suicide as women. African Americans experienced a risk of suicide that was 61% lower than the risk of whites (RR=0.39, 95%CI=0.26, 0.59). Results show that in general, the lower the level of education, the higher the risk of suicide. As for income, only those in households with incomes between $5000 and $9999 (inclusive) had a significant suicide risk (RR=1.47, 95%CI=1.06, 2.05). Residents of Western states had much higher risks of suicide (RR=1.40, 95%CI=1.09, 1.81). Older adults maintained higher suicide risks even after controlling for all other variables in the equation (model 2, table 2). Persons 55–64 years old were 41% more likely to kill themselves than youths (15–24). Those 65 years or older had a suicide risk that was 61% higher than the risk exhibited by people 15–24 years of age.

FINDINGS ON EFFECT MODIFICATION
As sex exerted the strongest effect on suicide, it was important to investigate whether it modified the impact of marital status. Indeed, evidence from some social science studies on homicide and other violent causes of death suggest that marital status may affect men and women differently.[15 22] Effect modification was examined by computing statistical interactions between sex (male=1) and each marital status category, and then including them in the multivariate hazards regression equation for the

Table 2 Population size, distribution of suicides, crude and adjusted relative risks by marital status: men

Marital status	Suicides	Population at risk	Model 1† RR	Model 1† 95% CI	Model 2‡ RR	Model 2‡ 95% CI
Marital status						
Married	241	139 323	1.00	(Reference)	1.00	(Reference)
Single	118	61 842	1.16	0.86, 1.56	1.15	0.85, 1.56
Divorced	57	14 275	2.47***	1.84, 3.30	2.38***	1.77, 3.20
Widowed	15	5 191	1.58	0.91, 2.72	1.50	0.87, 2.59
Unknown	1	2 888	0.21	0.03, 1.56	0.06	0.00, 0.94
Race/ethnicity						
White	412	191 433	1.00	(Reference)	1.00	(Reference)
African American	20	19 937	0.49***	0.31, 0.78	0.40***	0.25, 0.63
Hispanic	20	12 149	0.81	0.52, 1.28	0.68	0.43, 1.08
Education						
16+ years	48	36 683	1.00	(Reference)	1.00	(Reference)
0–8	82	34 251	1.75***	1.20, 2.54	1.66***	1.12, 2.47
9–11	84	42 113	1.52**	1.05, 2.19	1.47**	1.01, 2.14
12	145	72 846	1.52***	1.09, 2.11	1.48**	1.06, 2.07
13–15	71	35 005	1.57***	1.09, 2.27	1.51**	1.04, 2.20
Unknown	2	2 619	0.60	0.14, 2.50	7.06**	1.03, 48.25
Household income						
$25 000+	107	64 799	1.00	(Reference)	1.00	(Reference)
<$5000	44	15 698	1.76***	1.22, 2.52	1.57***	1.07, 2.30
$5000–$9999	84	29 933	1.73***	1.28, 2.32	1.60***	1.18, 2.19
$10 000–$19 999	110	67 013	1.01	0.77, 1.32	0.95	0.72, 1.25
$20 000–$24 999	68	31 791	1.31	0.97, 1.78	1.26	0.93, 1.71
Unknown	19	14 285	0.80	0.49, 1.30	0.87	0.52, 1.43
Region of country						
Non-West	377	210 719	1.00	(Reference)	1.00	(Reference)
West	55	21 800	1.38**	1.03, 1.83	1.35**	1.01, 1.80
Age (y)						
15–24	101	54 437	1.00	(Reference)	1.00	(Reference)
25–34	79	49 126	0.84	0.64, 1.10	0.87	0.65, 1.16
35–44	101	57 738	0.78	0.75, 1.26	1.05	0.77, 1.43
45–54	55	29 727	0.99	0.72, 1.37	1.07	0.73, 1.57
55–64	63	27 894	1.29	0.95, 1.75	1.32	0.91, 1.92
65+	67	28 167	1.65***	1.22, 2.22	1.42	0.96, 2.11
LRS					10 485.86	
Model χ^2					109.12***	
df					22	
Number of suicides:		432				
Number of observations:		223 519				

Source: The National Longitudinal Mortality Study, 1979–1989. †Relative risks (RR) adjusted for age only. ‡Relative risks (RR) adjusted for age, race, sex, education, income, and region of residence. **Significant at p<0.05, ***significant at p<0.01. LRS = Likelihood ratio statistic, df = degrees of freedom.

entire sample. Results showed that two of the interactions (sex * divorce, and sex * single) were statistically significant (p < 0.01), but no marital status category had a significant (unique) effect on suicide.

The log-likelihood for the interaction (expanded) model was 13823.23. It was 13841.62 for the reduced (no interaction) model. The no interaction assumption was tested by subtracting the log-likelihood of the expanded model from that of the reduced model as shown below:

$$\Delta LRS = LRS_R - LRS_E)$$

where the subscripts $_R$ and $_E$ refer to the reduced (no interaction) and expanded (interaction) models respectively. Under the assumption that the no interaction model is correct, the LRS has an approximate χ^2 distribution.[20] There were four product terms in the interaction model (sex * divorce, sex * single, sex * widowed, and sex * unknown marital status), so the no interaction hypothesis was tested using 4 degrees of freedom. The computation yielded 13841.62–13823.23 = 18.39. At 4 degrees of freedom, this χ^2 value was highly significant (p < 0.01). Accordingly, the null hypothesis of no interaction was rejected. Clearly, sex modifies the effect of marital status on suicide. In view of the foregoing, separate equations were tested for men and women.

KEY POINTS
- Increased risks of suicide were observed among divorced and separated men, but not among women.
- However, being single or widowed had no significant effect on suicide.
- Results obtained remained even after adjusting for socioeconomic and demographic variables.
- The effect of divorce on suicide risk may be attributable to absence of social integration, and increased psychological distress.
- Accordingly, socioeconomic variables should be taken into account in epidemiological research on suicide.

FINDINGS ON MEN

Table 2 shows the results of the analysis based on men. There were 223 519 men 15 years of age or more in the NLMStudy with known values for the study variables; 432 of these died from suicide from 1979 to 1989.

Model 1 presents age adjusted relative risks. Divorced men were nearly 2.5 times more likely to die from suicide than married men (RR=2.47, 95%CI=1.84, 3.30). No other marital status category reached statistical significance by conventional criteria.

Table 3   Population size, distribution of suicides, crude and adjusted relative risks by marital status: women

Marital status	Suicides	Population at risk	Model 1†		Model 2‡	
			RR	95% CI	RR	95% CI
Marital status						
Married	69	140 646	1.00	(Reference)	1.00	(Reference)
Single	14	54 668	0.62	0.31, 1.21	0.68	0.34, 1.35
Divorced	12	23 318	1.10	0.60, 2.05	1.27	0.67, 2.41
Widowed	16	28 891	0.86	0.46, 1.59	1.01	0.53, 1.91
Unknown	2	880	4.81**	1.17, 19.71	6.78**	0.95, 48.00
Race/ethnicity						
White	104	209 145	1.00	(Reference)	1.00	(Reference)
African American	4	25 852	0.33**	0.12, 0.90	0.36**	0.13, 1.01
Hispanic	5	13 406	0.82	0.33, 2.03	0.82	0.32, 2.05
Education						
16+ years	12	28 305	1.00	(Reference)	1.00	(Reference)
0–8	15	35 260	0.77	0.35, 1.70	0.91	0.40, 2.07
9–11	22	47 802	1.10	0.53, 2.25	1.18	0.57, 2.45
12	43	97 807	1.01	0.53, 1.92	0.97	0.50, 1.87
13–15	20	38 653	1.26	0.61, 2.59	1.23	0.60, 2.53
Unknown	1	576	4.24	0.55, 32.69	1.09	0.07, 16.55
Household income						
$25 000+	23	61 582	1.00	(Reference)	1.00	(Reference)
<$5000	9	29 031	0.67	0.30, 1.49	0.76	0.32, 1.80
$5000–$9999	18	40 197	1.02	0.53, 1.93	1.08	0.55, 2.12
$10 000–$19 999	41	72 362	1.46	0.87, 2.45	1.50	0.83, 2.54
$20 000–$24 999	16	31 274	1.38	0.72, 2.61	1.39	0.73, 2.65
Unknown	6	13 957	0.98	0.39, 2.44	0.78	0.28, 2.14
Region of country						
Non-West	97	225 136	1.00	(Reference)	1.00	(Reference)
West	16	23 267	1.78**	1.04, 3.03	1.65	0.96, 2.82
Age (y)						
15–24	13	56 726	1.00	(Reference)	1.00	(Reference)
25–34	18	51 994	0.97	0.54, 1.74	0.87	0.47, 1.59
35–44	24	60 788	1.28	0.73, 2.23	1.12	0.60, 2.07
45–54	18	32 295	1.81	0.96, 3.40	1.59	0.78, 3.25
55–64	19	31 637	2.01**	1.08, 3.73	1.76	0.86, 3.58
65+	26	39 761	2.47***	1.39, 4.39	2.43***	1.17, 5.04
LRS					2763.25	
Model χ^2					36.27**	
df					22	
Number of suicides:		113				
Number of observations:		248 290				

Source: The National Longitudinal Mortality Study, 1979–1989. †Relative risks (RR) adjusted for age only. ‡Relative risks (RR) adjusted for age, race, sex, education, income, and region of residence. **Significant at p<0.05, ***significant at p<0.01. LRS = Likelihood ratio statistic, df = degrees of freedom.

At the bivariate level (table 2, model 1), African American men were 51% less likely to commit suicide than white men. Lower levels of education and income increased suicide risk. Men residing in the West were more likely to commit suicide than those residing elsewhere in the country. The only age group that seemed to be at an increased risk of suicide was the group 65 years or older.

After adjustment for the other covariates (race, education, income, region of residence, and age), the excess risk of suicide among divorced men was reduced, but not eliminated. It remained significantly higher than that of married men. In the expanded equation (model 2) divorced men were 2.3 times as likely to die from suicide as their married counterparts (RR=2.38, 95%CI=1.77, 3.20). The suicide risk of the widowed, though increased (compared with that of married men) did not reach statistical significance.

The adjusted effects of the covariates in model 2 are relatively similar to the crude effects shown in model 1. African American men were less likely to kill themselves as white men (RR=0.40, 95%CI=0.25, 0.63). Men with low levels of education were significantly more likely to experience suicide than those with 16 years of schooling or more. Similarly, men in the lowest income groups had increased risks of suicide. For example, men with household incomes under $5000 were 76% more likely to commit suicide than men with household incomes $25 000 or more. Men whose household income was in the $5000–$9999 range had a risk of suicide that was 1.6 times that of men with household incomes $25 000 or more. Men in the West were 1.3 times as likely to kill themselves as those in the rest of the United States. In the multivariate results, age was unrelated to suicide.

findings on women
Table 3 presents results of the effect of marital status on suicide among women. In the NLMS, there were 248 290 women that had known values for the independent variables. Of this number, 113 died from suicide during the follow up period from 1979 to 1989.

As can be seen in table 3, there was no significant difference in the risk of suicide by marital status among women.

In addition to marital status effects, there were other notable differences between men and women. Low educational attainment was a risk factor for suicide among men. In the female equations (both models 1 and 2) education had no effect on suicide. Whereas low income increased the risk of suicide among men, income seems unrelated to suicide among women. Western region residence was related to suicide among women at the bivariate level, but it lost statistical significance in the adjusted equation (table 3, model 2). It is also interesting to note that while age was unrelated to suicide among men, it was a significant risk factor for women. Specifically, women in the age group 65 years or more were over 2.4 times as likely to commit suicide as women 15–24 years old.

Discussion

This study examined the risk of suicide across marital status groups in the United States using a large nationally representative sample, the NLMS.

Data analysis revealed that marital status is associated with the risk of suicide, and that divorce and separation have the strongest association. Indeed, when adjustments were made for such potential confounders as age, race, education, income, and region of residence, divorce/separation was the only status category that showed a significant increased risk of suicide.

How can the linkage between marital status, and divorce in particular and suicide be explained? It may be that marriage confers health and many other advantages that divorced persons lack. As indicated by Verbrugge,[23] marriage offers security and social support, and as a result, the married may be happier than the divorced. Indeed, epidemiological and psychological studies show that divorced persons are strongly represented in the psychiatric patient population.[5 14] As clinical depression is often a prelude to suicide, poor mental health probably accounts for the higher risk of suicide observed among divorced people.

In an effort to explain the relation between marital status and suicide, Durkheim[1] used the concept social integration, referring to the strength of the person's ties to society and the stability of social relations within that society, marriage being one of them.[24] One source of suicide, which he described as anomic, was the result of a sudden and unexpected change in a person's social standing, for example, a shift from being married to being divorced or widowed.[1] According to Durkheim,[1] married persons enjoy what he called a greater "coefficient of preservation" because married life provides a sense of cohesiveness and support that is not available to single, divorced, or widowed persons. Divorce disrupts this cohesion, and accordingly the former increases the risk of suicide.

From the Durkheimian perspective, divorce is an anomic condition characterised by low integration. For many people, the loss of social support and family integration through divorce is an inherently stressful life crisis that may lead to severe psychological distress, which could culminate in suicide.[25–27]

In the United States (and perhaps in many other western societies), there is a strong cultural emphasis on achieving a successful and happy marriage. As Stack[26] points out, national opinion polls in the United States usually report good health as being only second to achieving a happy marriage. You might argue that divorce promotes suicide partly as a result of this emphasis on a successful and happy marriage. People who have divorced—that is, failed in their marriages—may be at increased risk for suicide in view of the fact that they have failed to achieve one of the key goals set up by American culture.

Results have also shown that while marital status, especially divorce increases the risk of

suicide in men, the same cannot be said of women. In other words, the effect of marital status on suicide depends on sex. One possible explanation for the observed differentials by sex is that perhaps women form greater supportive networks, such as meaningful friendships at a higher level than men, and regardless of their marital status. Accordingly, even if a marriage ends in divorce or widowhood, women can fall back on their friendship networks for emotional and social support. It may be that men form less meaningful and fruitful supportive social bonds and networks. Accordingly, when a marriage breaks, men have no safety net.

Viewed within the above perspective, although both men and women may experience stress and discomfort because of marital breakdown, for men, affiliative losses may account for the stress.[1] [27] On the other hand, for women, economic losses may account for stress, given that they may already have some forms of social support.[28] Unfortunately, the data used here do not allow for an empirical test of these speculations.

It may well be that although divorce is a crisis and a profoundly stressful life event for many people, men and women react to the crisis and stress differently. Men kill themselves, but women do not. The foregoing statement, however, needs a serious qualification. The present research has studied only suicide mortality, but there exists an extensive literature on suicide morbidity.[29–31] These studies have shown a male-female ratio in attempted suicide or parasuicide as being consistently below unity, implying that women engage far more in suicidal acts (including suicide ideation and parasuicide) than men. While the present research has found no marital status differences in suicide among women, there remains the possibility that if the suicide data were analysed by method of death, some significant differences might be found. The rationale for this speculation is based on my assumption that people attempting suicide, but perhaps not actually wishing to complete the process are more likely to use less lethal methods than persons desiring complete death. It may well be found that perhaps men use firearms and other more efficient techniques of effecting death, while women use cuttings, medications, and other less life threatening methods.

Results from the analysis cast serious doubt on observations that have been made in the literature that the sexes have become alike with regards to their suicide risks, and the factors that account for these risks.[30] [32] [33] Based on the analysis, there is no evidence for Neuringer's comment that the sex differential in suicide has disappeared.[33] There still exist male-female differences, and the finding with regard to marital status clearly illustrates a gender differential. It is important to note that socioeconomic status affects men and women differently in terms of suicide risk. Low educational attainment and income are significant risk factors for men, but not for women. Another remarkable finding regarding the control variables is that age seems unrelated to suicide among men. Among women, however, the elderly (65+) are at an especially high suicide risk.

This study has implications for past and future research in epidemiology and public health. The first is that in mortality, but especially in suicide research, it is not enough to adjust relative risks for only age. Failure to control for the effects of potentially confounding variables, such as socioeconomic status may lead to the drawing of false inferences. For example, in their research, Smith and his colleagues found that all other marital status groups had increased risks of suicide than the married.[2] Yet their study controlled for only age. In the present investigation, it was observed that once socioeconomic and demographic factors are controlled, only divorce is a significant risk factor for suicide. Being widowed or single (never married) has no statistically significant effect on suicide.

Another implication of the findings for public health is that in epidemiological research, investigators need to be sensitive to stratifying their samples on the basis of some meaningful demographic or social characteristic. For example, although men are reported to commit a disproportionate number of suicides, failure to stratify by sex, or combining men and women in the same models might yield misleading results. Indeed, it has been found that sex modifies the effect of marital status on suicide.

The findings reported here support those of Meehan *et al.*[34] In their study, divorced men had the highest rate of suicide. Results, however, contradict those of Charlton.[35] In Charlton's report, being widowed/divorced or not stating marital status increased the risk of suicide. Being single was also found to be a significant risk factor for suicide. In the present study, only divorce significantly increased suicide risk. This research failed to reproduce or support Charlton's contention that women of all ages are at increased risk of suicide.[35] Instead, it was found that only elderly women (those 65 years old or over) have significant risks of suicide. Perhaps one reason why the current study disconfirmed the Charlton study was that the author lumped the widowed and divorced in the same category. Another possibility is that he relied on cross sectional data, and he compared suicides with deaths from natural causes as controls (instead of persons at risk).

Results also contradict some of those reported by Burnley on suicides in New South Wales, Australia.[36] Burnley observed marital status variations in suicide risk for both genders. As we have seen, however, marital status variations in suicide exist only among men.

This study has some limitations that the reader should bear in mind when interpreting the results. Firstly, marital status is a time varying covariate, and the length of time that a given person was in a particular marital status category before suicide could not be ascertained from the data. Yet, it is conceivable that in a given survey year, a person may be married, but get divorced that same year. Similarly other persons may be divorced, single, or widowed, but get married or switch between

statuses. In any case, it cannot be assumed that those who continued in one marital status group during the entire follow up period, and those who moved out are equivalent with regard to suicide risk. Although from a statistical point of view prediction errors resulting from these changes in marital status categories may, to some extent cancel each other out within a survey year, it would still be preferable to have information on marriage duration if feasible.

Secondly, married people (used here as the reference group) may experience the lowest risk of suicide because of matrimonial selection.[2] Perhaps those who married and stayed married are in some unknown way different from the rest of the population. For example, they may be healthier than divorced persons. As explained by Verbrugge,[23] when a spouse becomes chronically ill, rising dissatisfaction and economic difficulties may cause some couples to separate or divorce, and the ill spouse may have problems remarrying. He may also be at an increased risk of mortality from various sources, including suicide. Thus, while marital status causes differences in exposure to health risks, health status can influence marital dissolution.

Thirdly, married people may enjoy immunity from suicide relative to other marital status groups not because of factors unique to marriage or the married life, but rather the unique circumstances faced by divorced people (for example, loss of an integrative family unit), and widowed persons (for example, bereavement).

Despite the above limitations, the findings here further add to our understanding of the impact of marital status on suicide.

Recent epidemiological studies have begun to investigate the effect of marital status on other forms of morbidity and mortality, for example coronary heart disease,[37] and all cause mortality.[38] In general, these and other studies have confirmed the health disadvantages of not being married. It is hoped that results reported here will stimulate even more research in an effort to generate theories and empirical work to further explore the rather complex link between marital status, and morbidity and mortality.

1 Durkheim E. *Suicide: a study in sociology*. New York: The Free Press, 1897.
2 Smith JC, Mercy JA conn JM. Marital status and the risk of suicide. *Am J Public Health* 1988;**78**:78–80.
3 Kposowa AJ, Breault KD, Singh GK. White male suicide in the United States: a multivariate individual-level analysis. *Social Forces* 1995;**74**:315–23.
4 Kachur SP, Potter LB, James SP, Powell KE. *Suicide in the United States, 1980–1992* Atlanta: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 1995.
5 Hassan R. *Suicide explained.* Melbourne: Melbourne University Press, 1995.
6 Breault KD. Suicide in America: a test of Durkheim theory of religious and family integration. *American Journal of Sociology* 1986;**92**:628–56.
7 National Heart, Lung, and Blood Institute. *National Longitudinal Mortality Study, 1979–1989 [Machine-Readable Public Use Data Tape].* Bethesda, MD: National Institutes of Health, 1995
8 Rogot E, Sorlie PD, Johnson NJ, *et al. A mortality study of one million persons by demographic, social, and economic factors, 1979–1981 follow-up.* Washington, DC: Department of Health and Human Services, 1988.
9 Rogot E, Sorlie PD, Johnson NJ, *et al. A mortality study of 1.3 million persons by demographic, social, and economic factors: 1979–1985 follow-up.* Washington, DC: National Institutes of Health, 1992.
10 US Bureau of the Census. *The current population survey: design and methodology* Washington, DC: US. Bureau of the Census, 1978: technical paper 40.
11 Sorlie PD, Backlund E, Keller JB. US mortality by economic, demographic, and social characteristics: the National Longitudinal Mortality Study. *Am J Public Health* 1995;**85**:949–56.
12 National Center for Health Statistics. *National Death Index Users Manual.* Hyattsville, MD: NCHS 1990: DHHS publication PHS 90–1148.
13 Health Care Financing Administration. *The international classification of diseases, 9th revision, clinical modification, 4th edition.* Washington, DC: Public Health Service; 1991. Report Number PHS-91–1260.
14 Kreitman N. Suicide, age and marital status. *Psychol Med* 1988;**18**:121–8.
15 Kposowa AJ, Adams M. Motor vehicle crash fatalities: the effects of race and marital status. *Applied Behavioral Science Review* 1998;**6**:69–91.
16 Breault KD, Kposowa AJ. Explaining divorce in the United States: A study of 3,111 counties, 1980. *Journal of Marriage and the Family.* 1987;**49**:549–58.
17 US Bureau of the Census. *Statistical abstract of the United States, 1996.* Washington, DC: Government Printing Office, 1997.
18 Cox DR. Regression models and life tables (with discussion). *Journal of the Royal Statistical Society* 1972;**34B**:187–220.
19 SAS Institute, Inc. *SAS/STAT Software: The PHREG procedure, version 6.12.* Cary, NC: SAS Institute, 1998.
20 Kleinbaum DG. *Survival analysis.* New York: Springer-Verlag,; 1996.
21 Long JS. *Regression models for categorical and limited dependent variables.* Thousand Oaks, CA: Sage Publications, 1997.
22 Kposowa AJ, Singh GK. The effect of marriage on male and female homicides in the United States. *Sociological Focus* 1994;**27**:343–62.
23 Verbrugge LM. Marital status and health *Journal of Marriage and the Family* 1979; **41**:267–85.
24 Hassan R. One hundred years of Emile Durkheim's suicide: a study in sociology. *Aust N Z J Psychiatry* 1998;**32**:168–71.
25 Trovato F. The relationship between marital dissolution and suicide: the Canadian case. *Journal of Marriage and the Family* 1986;**48**:341–8.
26 Wasserman I. Imitation and suicide: A re-examination of the weather effect. *American Socioliological Review* 1984;**49**:427–36.
27 Stack S. New micro-level data on the impact of divorce on suicide, 1959–1980: a test of two theories. *Journal of Marriage and the Family* 1990;**52**:119–27.
28 Gerstel N, Riessman CK, Rosenfield S. Explaining the symptomology of separated and divorced women and men: the role of material conditions and social networks. *Social Forces* 1985;**64**:84–101.
29 Rossow I. Suicide, alcohol, and divorce; aspects of gender and family integration. *Addiction* 1993;**88**:1659–65.
30 McIntosh JL, Jewell BL. Sex difference trends in completed suicide. *Suicide Life Threat Behav* 1986;**16**:17–27.
31 Wenz FV. Marital status, anomie, and forms of social isolation: A case of high suicide rate among the widowed in an urban sub-area. *Dis Nerv Sys* 1977;**38**:891–5.
32 Hirsch MF. *Women and violence.* New York: Van Nostrand Reinhold, 1981.
33 Neuringer C. Affect configurations and changes in women who threaten suicide following a crisis. *J Consult Clin Psychol* 1982; **50**:182–6.
34 Meehan PJ, Saltzman LE, Sattin RW. Suicides among older United States residents: epidemiologic characteristics and trends. *Am J Public Health* 1991; **81**:1198–200.
35 Charlton J. Trends and patterns in suicide in England and Wales. *Int J Epidemiol* 1995; **24** (suppl 1):S45–52.
36 Burnley IH. Socioeconomic and spatial differentials in mortality and means of committing suicide in New South Wales, Australia, 1985–91. *Soc Sci Med* 1995;**41**:687–98.
37 Mendes de Leon CF, Appels AD, Otten FW, *et al*. Risk of mortality and coronary heart disease by marital status in middle-aged men in the Netherlands. *Int J Epidemiol* 1992; **21**:460–6.
38 Stroebe W, Stroebe MS. *Bereavement and health: the psychological and physical consequences of partner loss*. Cambridge: Cambridge University Press, 1987.